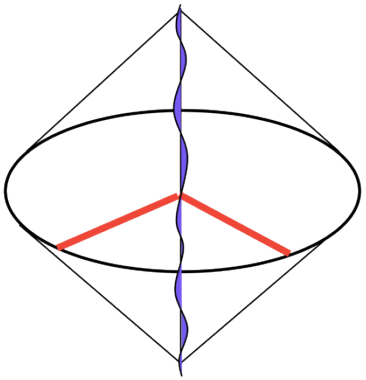
E990
THE HOLOMETER
MP7 & 8



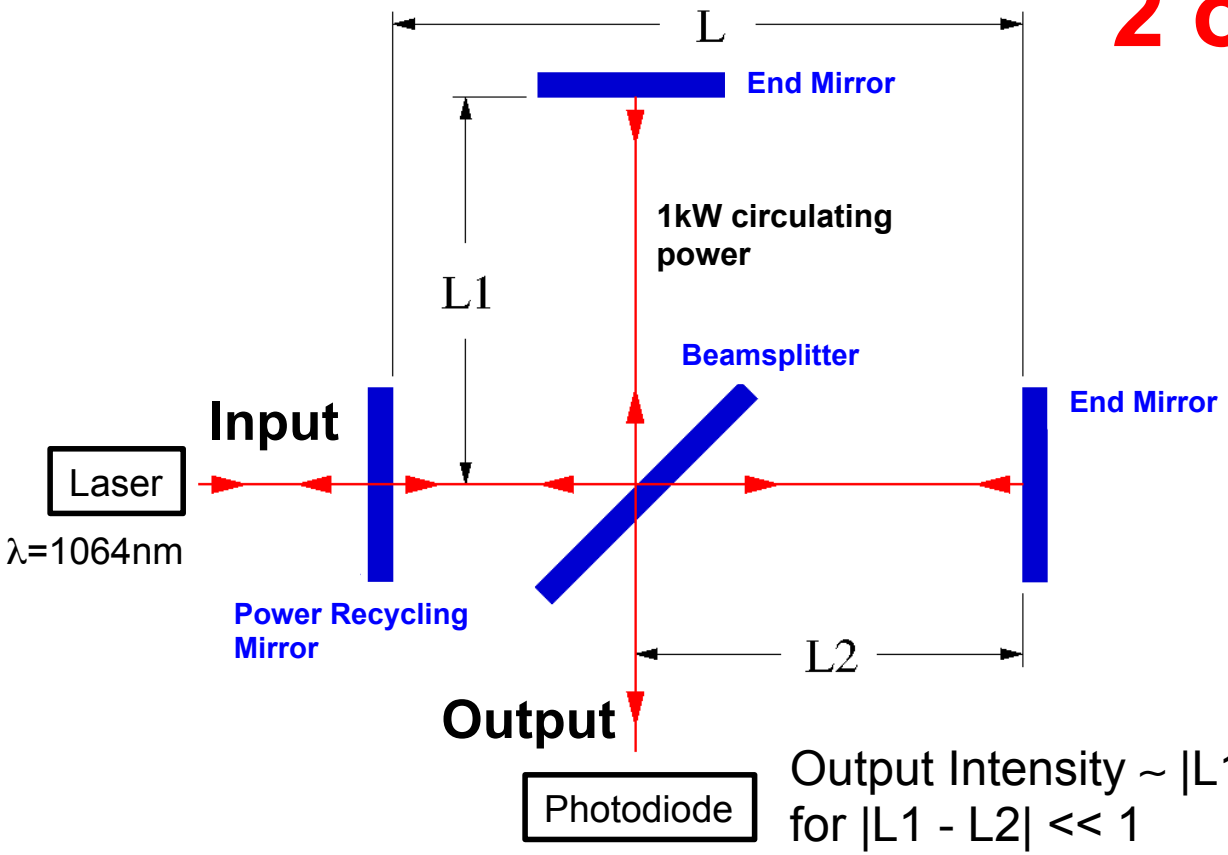
Status Report

Fermilab All Experimenter's Meeting
December 3, 2012
Bobby Lanza for the Holometer

The Holometer Instrument

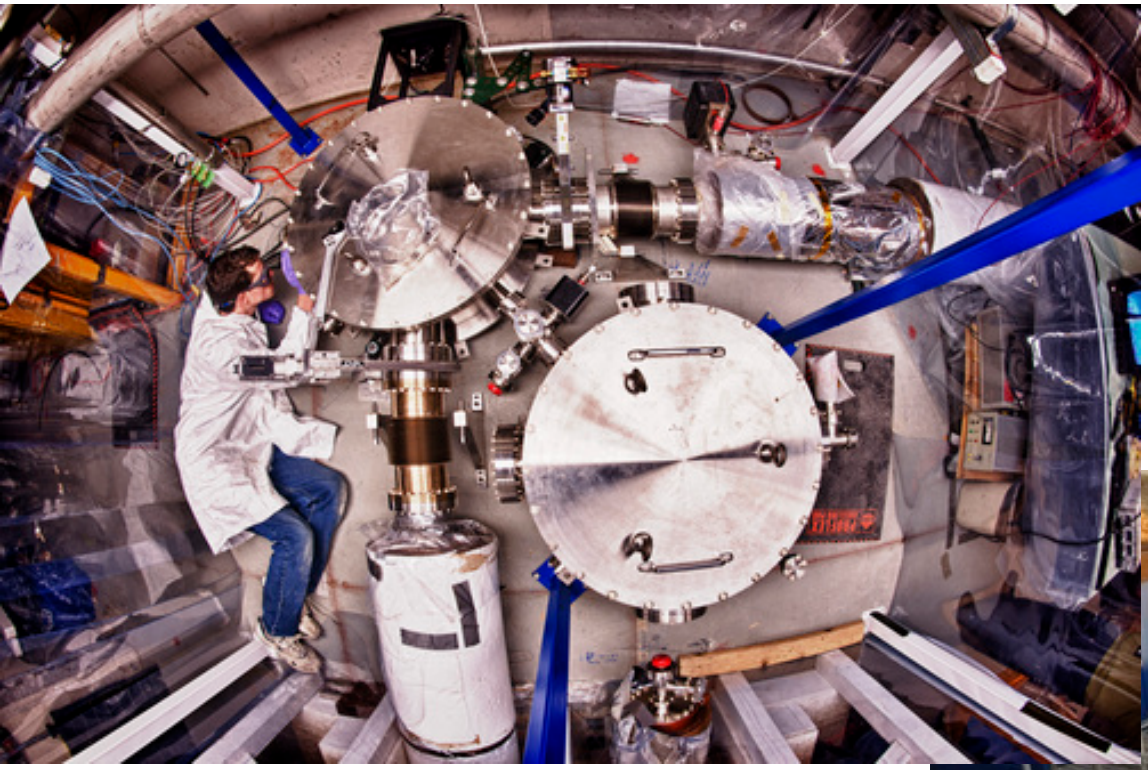
- Two nested power-recycled Michelson interferometers
- Optimized to detect a fundamental Planck scale uncertainty in the position of all objects

2 of these



Output Intensity ~ $|L1 - L2|^2$
for $|L1 - L2| << 1$

Two Interferometers Now Constructed



One set of arms is inside an old Fermilab meson beam tunnel.

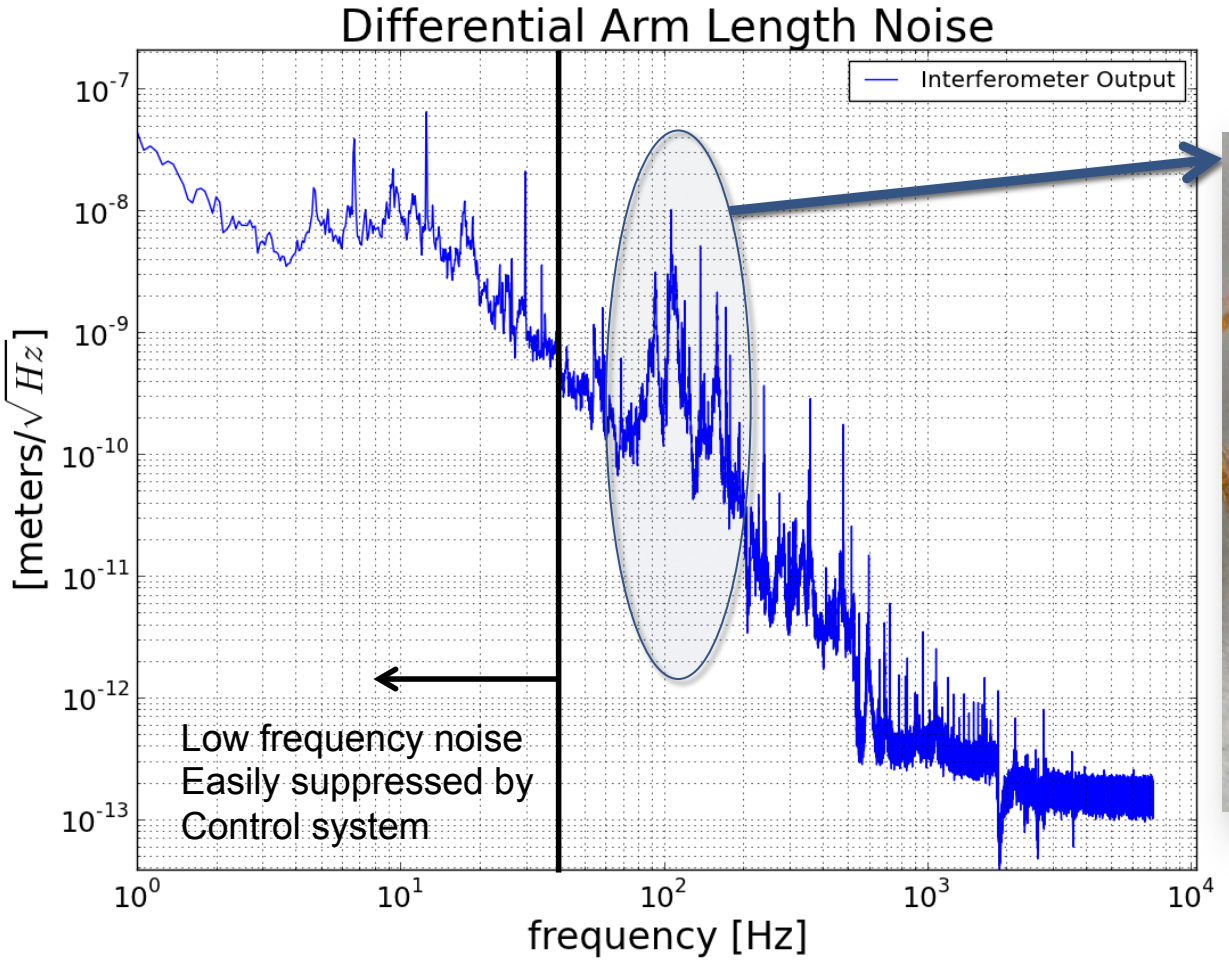
The other arms extend outside to a remote hut housing the end mirrors

Vacuum service vessels housing beamsplitters

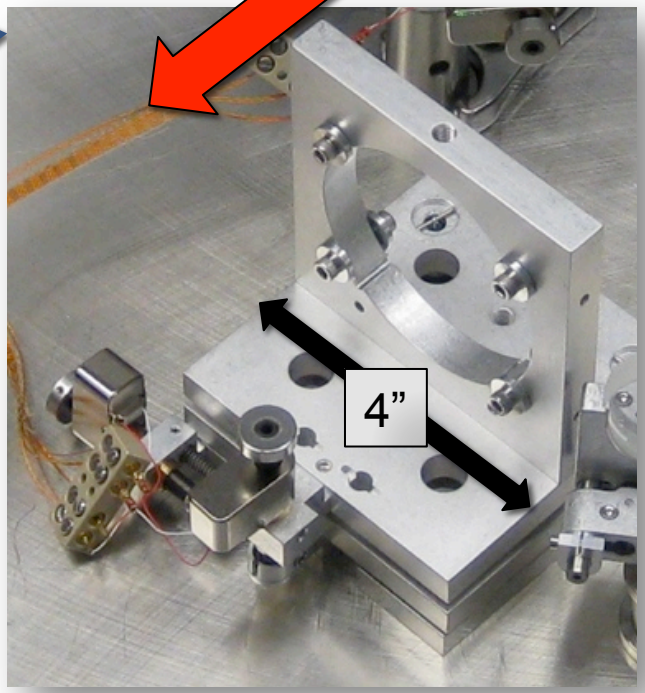
1e-8 torr ; low hydrocarbons

SEISMIC ISOLATION

Seismic Noise as Measured by Interferometer

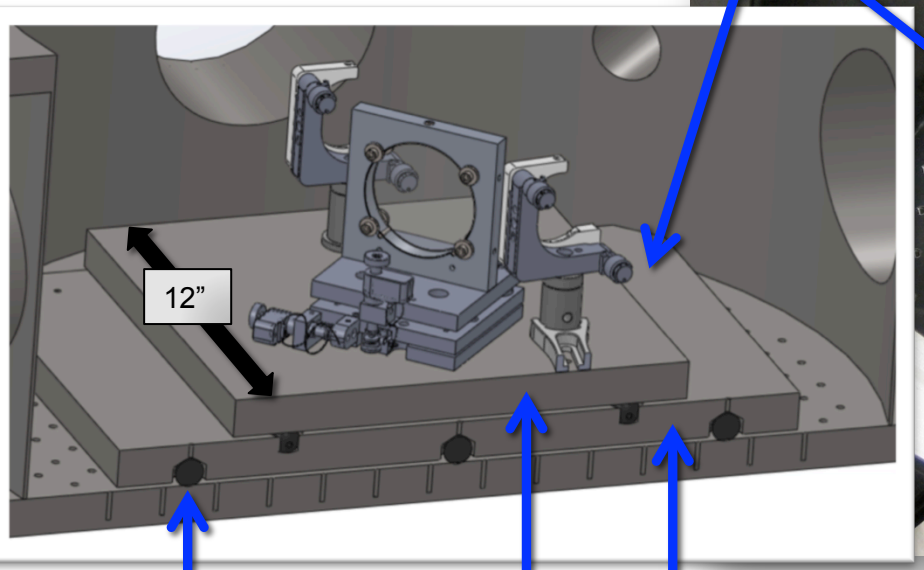


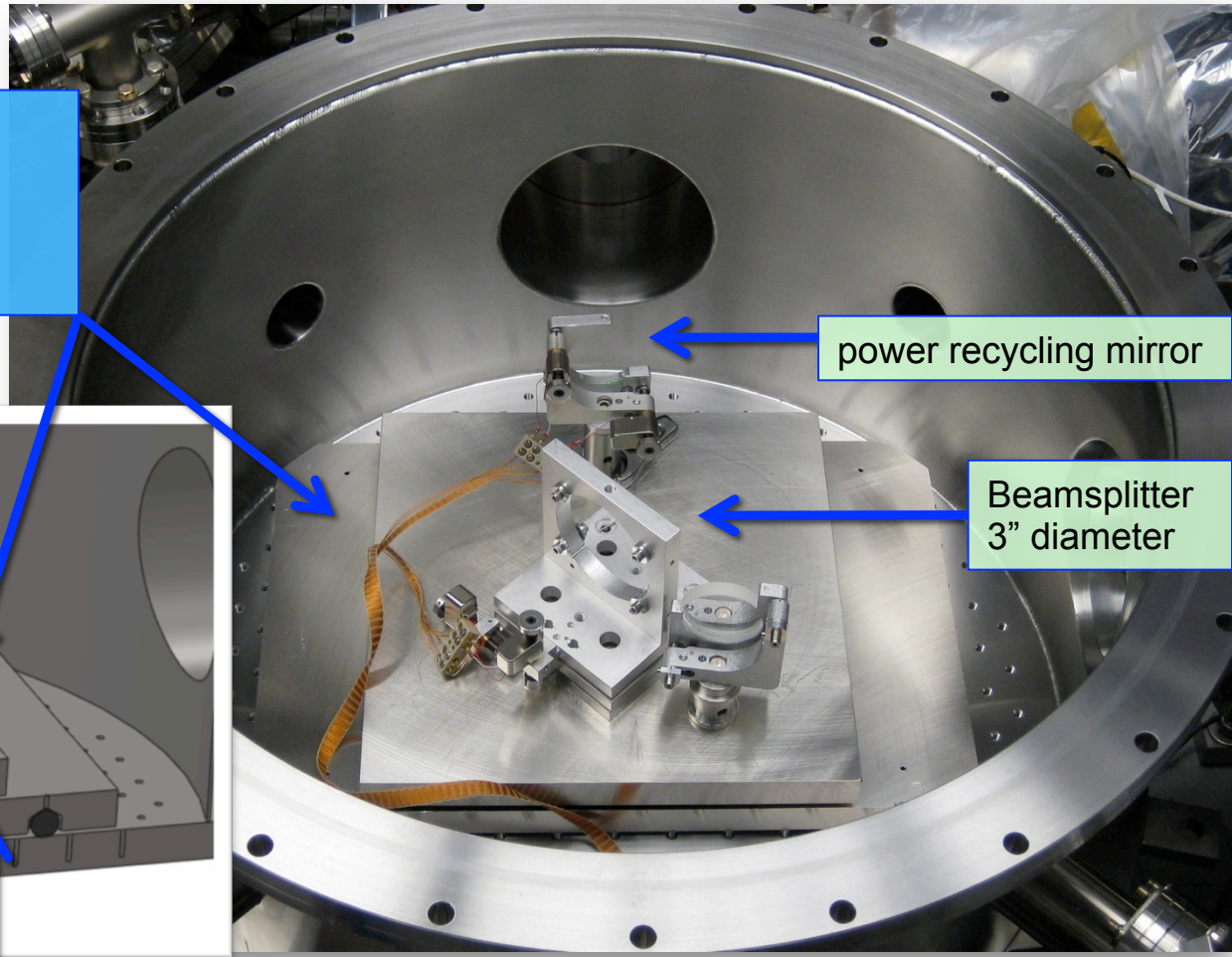
Beamsplitter Mechanical Resonance



Seismic Isolation installed in interferometer and tested

Passive
Seismic Isolation

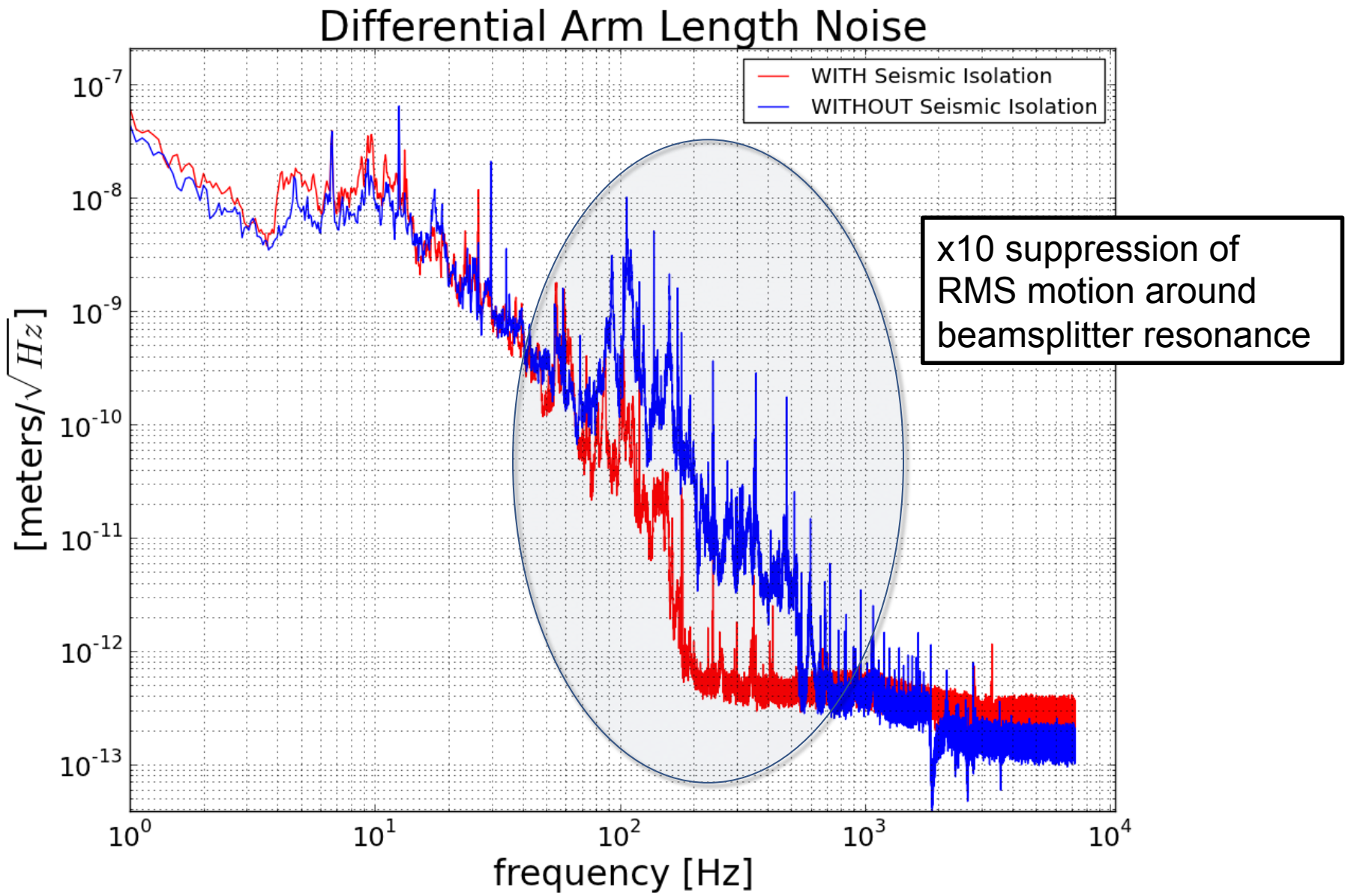




Viton balls

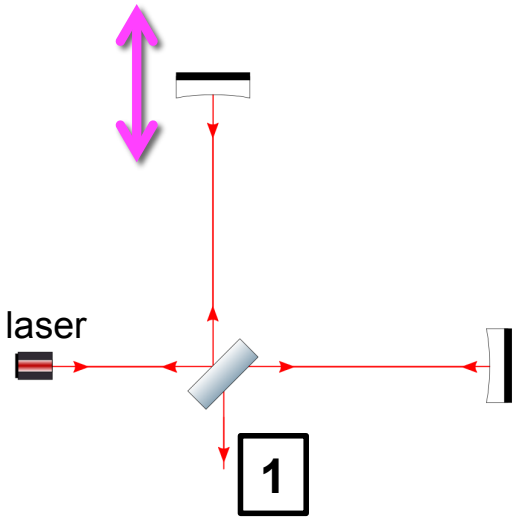
40 lb + 60 lb steel plates

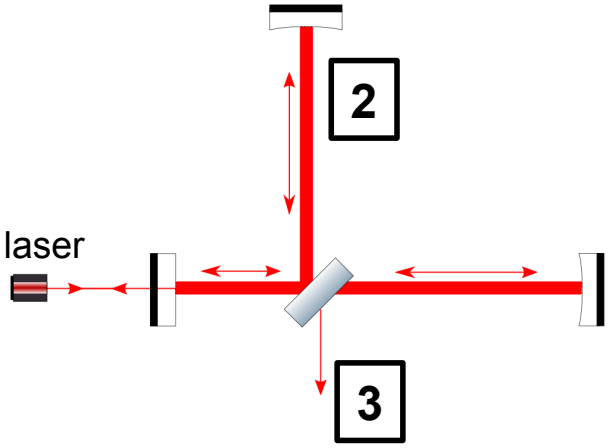
Seismically Driven Beamsplitter Motion Suppressed

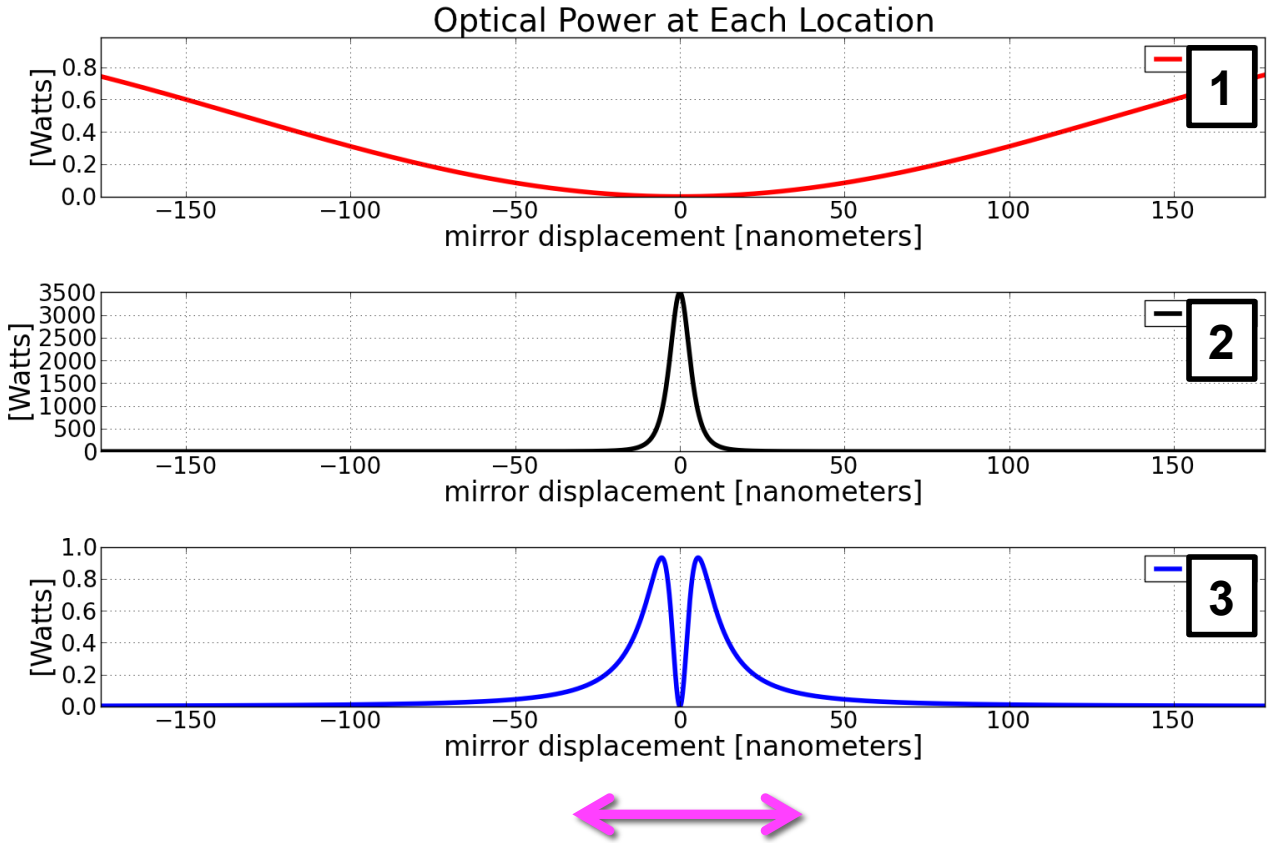


OPTICAL POWER BUILDUP

Predicted Power vs. Arm Length Difference

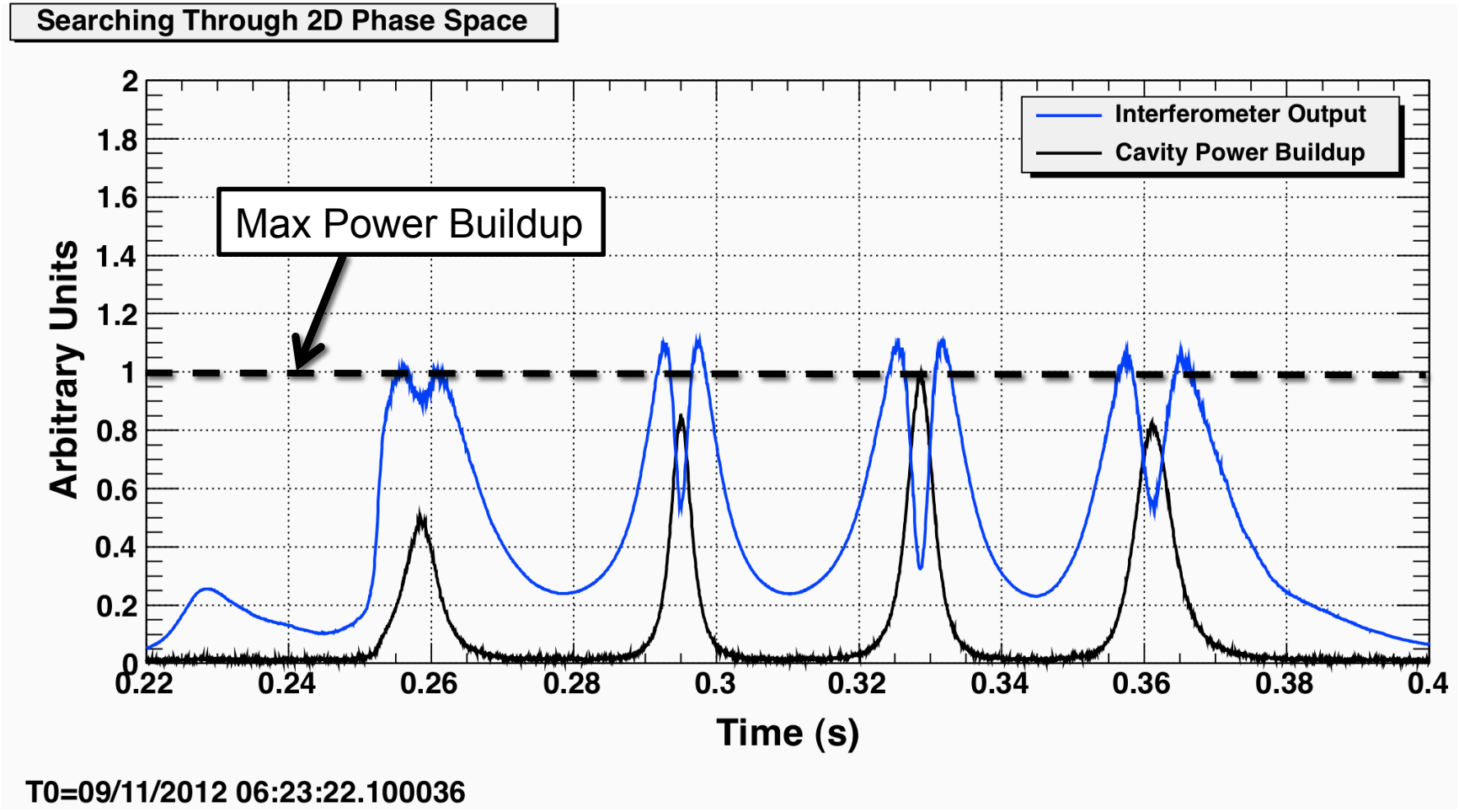




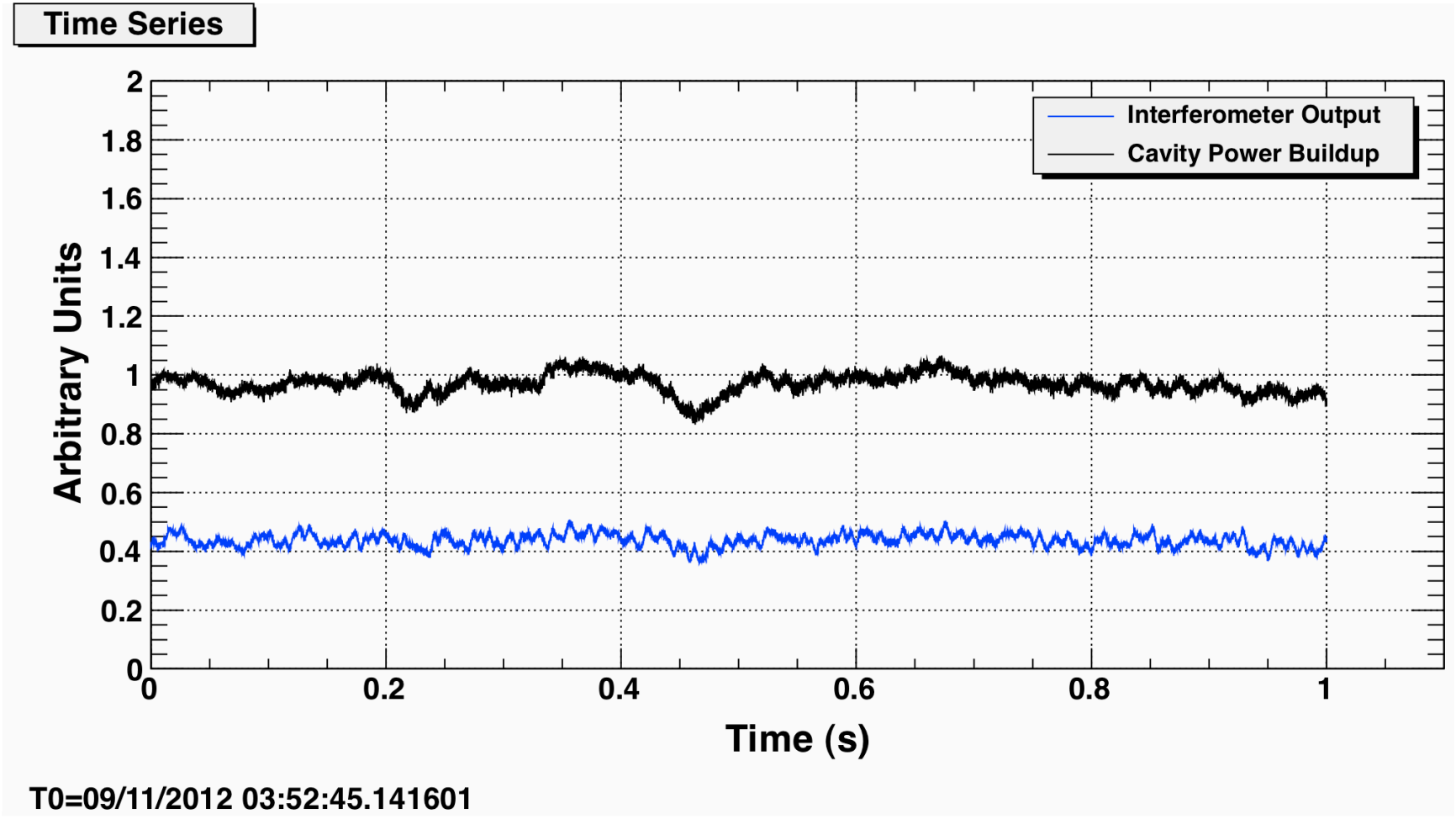


Measured Resonant Cavity Power Buildup

Modulating arm length difference and cavity resonance frequency by actuating end mirrors



Locked to Max Power Buildup



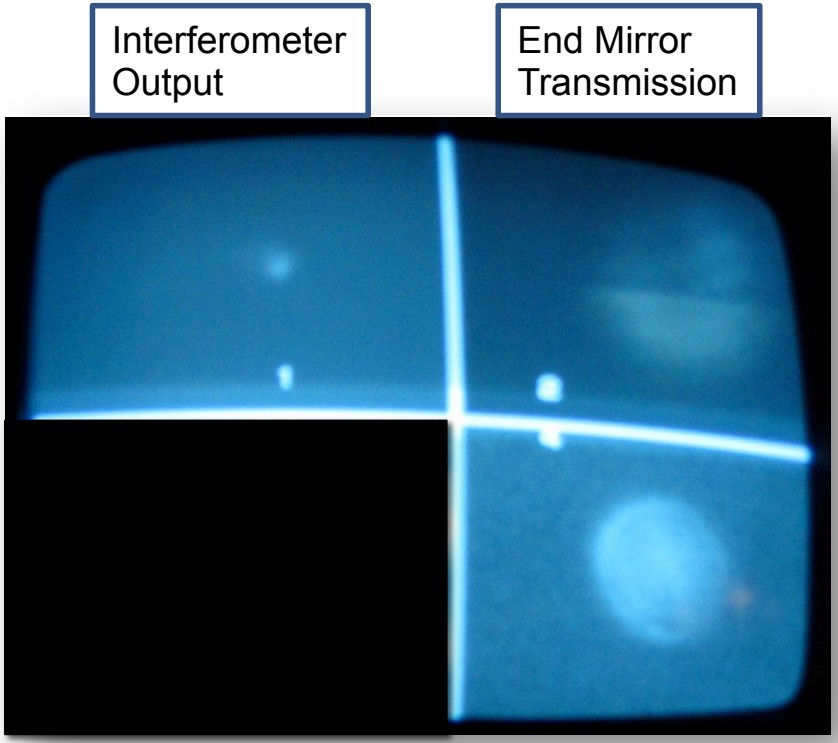
Power Recycling Summary

	Cavity Gain	Incident Power [Watts]	Circulating Power [Watts]
Expected	78 ± 24	1.5 ± 0.2	117 ± 39
Measured	79 ± 2	1.5 ± 0.2	119 ± 16

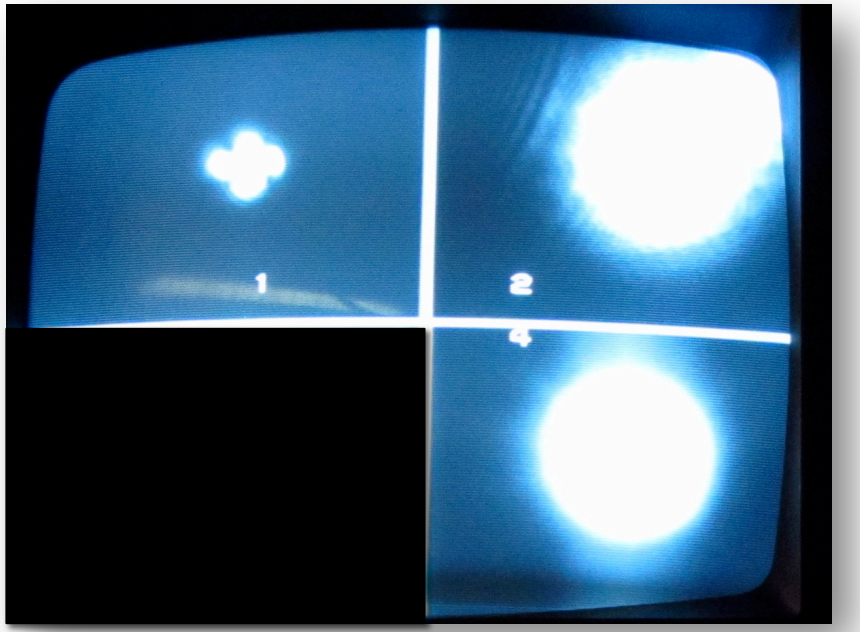
- **This is exactly as expected for this power recycling mirror**
- Installing 99.9% reflectivity power recycling mirror will allow us to reach 1kW.

Power Recycling Images

No Power Recycling



Power Recycling



Status / Schedule

- **Completed:**
  - MECHANICAL:
    - Two interferometers constructed
    - Ground noise discovered; solution installed and tested in one interferometer
  - OPTICS:
    - Achieved maximum power build-up using low-reflectivity mirrors: 100watts

- **Next Steps:**
  - Install beam splitter isolation in other interferometer **(this month)**
  - Further vibration isolation at end stations: designed and out for bid
  - Install high reflectivity optics
  - Stable operation at 1kW

The Holometer Team

- Fermilab:
  - A. Chou (co-PI, project manager), H. Glass, C. Hogan, C. Stoughton, R. Tomlin, J. Volk, W. Wester, A. Sippel
- MIT LIGO:
  - M. Evans, S. Waldman, R. Weiss
- UChicago:
  - S. Meyer (co-PI), B. Lanza, L. McCuller, J. Richardson
- U Michigan LIGO:
  - D. Gustafson
- Northwestern
  - J. Steffen
- Vanderbilt University
  - B. Kamai